CONQUER YOUR FEAR OF CODING WITH PRAAT SCRIPTING

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Chapter 0

Introduction

To a complete novice, learning to program may become a daunting experience. I myself have been through the endless cycle of:

- spending hours trying to figure out which programming language would better suit my ongoing needs;
- starting to learn the basics of that language;
- producing minor scripts (pieces of code accomplishing a task) with success;
- getting baffled by more intricate concepts;
- giving up after a few weeks for lack of focus and motivation[1];
- hitting the books 18 months later and having to go through the entire process all over again.

I am not a programmer by profession, just someone who will avoid repetitive work at any cost and who, without programming skills, would have wasted months upon months performing menial tasks.

Let me take you back to my teaching days. We would always start the semester by learning the basic keyboard shortcuts: Ctrl+X, Alt+F4, Ctrl+Alt+del, . . . ; about twenty-five shortcuts in total. There would always — and I mean *always* — be a student who would react n gatively. That student who would nag about the uselessness of learning something by heart. We all know who I am talking about (I am hoping you are not one of them; if so, maybe this book will change your mindset); we all have someone in mind. This is the typical dialogue that would occur during our first semester session:

STUDENT: I don't see the point in learning all this.
ME: Ok, open two folders and try to copy/paste a document from one folder to the other using your mouse.
STUDENT: (right-click > Copy > right-click > Paste) Done!
ME: How much did it take?
STUDENT: Four seconds! Am I fast or what?
ME: Now try the shortcut. Is it faster?
STUDENT: Yes, by two seconds but I am still not impressed.
ME: Now give me a rough estimate of the number of times you need to copy/paste throughout the year.
STUDENT: I still don't see the point but OK. . . 300 days * 100 repetitions. . . 30000 times!
ME: times 2?
STUDENT: . . . I am saving 60000 seconds? How is that possible?
ME: And that is how many hours?
STUDENT: . . . What the . . . ? 16.66 hours?!?

And that is by learning two simple shortcuts; now imagine being able to program! This book is mostly based on stories like this — and I've got plenty. We will construct various scripts together, line by line, while I will be explaining the reasoning behind each term, concept and choice.

[1] I have since figured out that learning a language for the sake of learning is suboptimal. One needs a specific project upon which to work. At least this is what works for me. I need to work towards a goal, an idea, a project.

0.1 What is programming?

Programming is a means of conveying your deepest desires to a computer that is supposed to make your dreams come true. Telling a computer to do anything requires the two of you speak the same language. This is why we have created programming languages: to communicate with machines as efficiently as possible by feeding them clear, specific instructions. Instructions are tasks such as:

- ❖ calculating the product of two numbers;
- ❖ creating a window and retrieving information from the user;
- ❖ copying a file from one folder to another.

When I take pictures with my Redmi Note 8 cell phone (Xiaomi people, this book is going global so please, do not forget my bonus check!), the operating system (Android) names the files using the following convention:

IMG_yyyymmdd_xxxxxx.jpg

Example:

IMG_20200501_012345.jpg

where ‘yyyy’ is the year (4 digits), ‘mm’ the month (2 digits), ‘dd’ the day of the month (2 digits) and ‘xxxxxx’ the serial ID of the file (6 digits). When I transfer photos to my computer, I cannot guess the content of each image unless I open it. Now let us say I wake up one morning and want to revisit all the incredible memories I have had during my globetrotting days by roaming through the millions of photos I have snapped. Say I am a messy person and have not organised my files using the KonMari method: how am I to find the right files? A simple search in the File Explorer would be useless unless I used criteria such as “Date created”. It is therefore wise to rename the image files according to the occasion. But renaming 100+ files by right-clicking then typing the new name is nuts! Who in their right mind would do that? I’ll tell you who: someone who does not know how to program or find programs that can perform this type of tasks! Or someone who has nothing better to do. Definitely not us, right?

0.2 Why use Praat?

Speech signal processing has been popularised during the past 20+ years following the development of a plethora of processing tools: WavePad, Speech Analyzer, Wasp, WinSnoori, WaveSurfer, xassp to name a few. As the number of tools has grown, so has the dire need to explore even larger databases in order to validate or shoot down working hypotheses. Unless you are courageously naive to analyse hours of recordings one acoustic event at a time, you need a basic knowledge of programming to automate complex audio processing tasks.

After analysing a few minutes of audio, you soon realise that programming is the right path to follow. Then come the fear, the panic and the self-doubt. You are confronted with significant dilemmas: which language to choose, which software, open-source vs. proprietary… MATLAB is one way to go and its advantages are obvious to the experienced user: reduced computational time, an abundance of features, a quick learning curve when coming from another programming language. Yet a mere glance at a piece of MATLAB code can get your heart rate skyrocket and have you run screaming for your mommy. To most nonprogrammers, terms such as “variable”, “loop”, “logical tree” and “algorithm” seem daunting, let alone learning an entire language and importing modules and classes. In addition, MATLAB is a proprietary software, which by itself is a prohibitory factor for someone on a limited budget. It may not be the appropriate tool for a programmer in the making.

And then comes Praat Boersma and Weenink (2001) to save the day. Open-source, customisable, free-of-charge, frequently updated, with a large community of users and an active forum, with a variety of freely available scripts designed by fellow enthusiasts and compatible with all major OS. Unlike Matlab and other languages, Praat is not a full-fledged programming language: you cannot design video games with it nor build websites or build a web server. It can, however, perform complex tasks. The syntax is straightforward and you do not need to work with a plethora of auxiliary files; your entire program can fit into a single script.

Praat is predominantly used by speech analysts — phoneticians, acousticians, speech pathologists, linguists, engineers — but that does not mean it should only be used for doing research. A programming language is a tool; it is up to the user to take advantage of its power and find meaningful applications for it. In this book, we will be using Praat:

- to build unit converters (kilometers to miles, Hertz to Bark...);
- to learn the first 100 digits of pi;
- to create a verb conjugator (say what???);
- to provide subtitles to a video;
- to do statistical analyses;
- to grade student assignments;
- to create a virtual piano and play the chorus of 'Jingle Bells';
- to create a 'Find the difference'-type game.

As you can see, the possibilities are limited only by your imagination.

0.3 Who should read this book

This manual is addressed to different groups of people:

- to computer users who would like to learn how to automate their everyday tasks;
- to computer users who would like to acquaint themselves with the basics of programming in order to move to a full-fledged programming language;
- to Praat users who understand acoustics and use Praat regularly but are unable/unwilling to process extensive amounts of data manually;
- to students of English literature whose professor suggested this book as a piece of writing master class;
- to aspiring stand-up comedians;
- to educators looking for a teaching manual for their class;
- to chill people looking for something to do while sipping on their boba tea.

This is by no means an introduction to acoustics. And, in case you are wondering, Praat — or any programming language for that matter — cannot accomplish tasks requiring decision making; this is what ChatGPT is for. Programming means telling the machine what to do, not the other way around. Asking from Praat to choose between a Fast Fourier Transform and a Linear Predictive Coding, to label segments or to find the silent parts in a recording automatically is not possible so prior choices will have to be made. If only I had a nickel for every time someone has told me "I want Praat to do this for me", I would not have to write this manual; I would most definitely be sunbathing on my private beach in the Bahamas. If you want someone/something else to do the work for you, hire an assistant.

No prior knowledge of programming is required. If you already know how to program, throw this book in the recycle bin. Or regift. Or keep reading for all the funny stories. It *is* a literary classic after all. If you do not believe me, ask my dear friend Oprah. This manual has been on her official book list since the day it hit the stores.

0.4 About this book

This book contains 23 chapters. Installing Praat will introduce you to the Praat interface, its windows and the concept of script files, preparing you for the rest of the book. Understanding the first chapters is crucial because they contain the most important elements of the Praat language: string and numeric variables, quotes, dollar signs, comments, loops, etc. These conventions might seem irrational to a beginner so patience is of utmost importance. Only when you have mastered the content of these chapters should you move on.

Chapters 1 to 7 introduce some basic notions such as variables, loops, data types and conditionals. As soon as you have mastered these notions, you will be able to get on with the juicy section of the book: building up projects with real-life applications. The chapters are relatively short and the projects somewhat restrained so that you can finish each chapter without getting a headache.

Chapters 8 to 21 are structured in the following fashion:

1. a funny quote will get you in the general mood. Believe me, my sense of humour might be the only thing keeping you from jumping out the window amongst the millions of lines of code;

2. the goal to be achieved is stated. What are we trying to build in the ongoing chapter and what do we have to learn in order to reach our destination?

3. the code is presented in bits. We try to construct the project one task at a time and add new lines to the existing code. **We will only be using code, commands and tricks that we have already learnt in the previous pages therefore some passages might seem non-optimal or even weird to an experienced user. This is part of the learning process**;

4. key concepts are revisited in a summary so that you can memorise them more easily;

5. challenges of varying difficulty (‘easy-peasy’, ‘I think I can do it’ and ‘no way in hell!’) are available at the end of the chapter.

Just for your entertainment, I have included five crossword puzzles. The first three cover key notions visited through chapters 1-7, 8-14 and 15-21. For the last two puzzles, you will have to do some research in the Praat manual since some notions or functions might have not been explained in the chapters. And as a bonus (because I am not as lazy as some people think), I have added Chapters 22 and 23 which will allow you to revisit many of the concepts you will have visited throughout this book.

After buying this book (legally of course or else I am sending Interpol after you!), you will be able to download a .zip file that contains:

- this pdf file;

- an 🗀 `examples` directory containing the final version of the script for all projects. File naming follows the format *exX_xxxxxxxx*, where *X* is the number of the corresponding chapter and *xxxxxxxx* a short text describing the nature of the project. This way, even if you don’t remember the precise chapter number, you will be able to guess the nature of the contained project;

- a 🗀 `workingFiles` directory containing the auxiliary files — sound files, text files, . . . — necessary to work on projects and challenges;

- a 🗀 `challenges` directory containing the answers for all the challenges. The files are named *chX.X* (the chapter number followed by the number of the challenge).

You should extract (unzip) the archive somewhere on your computer. The directory containing this pdf file will be your ‘working directory’ where you will be saving your scripts unless advised otherwise. Please **keep a copy of the original .zip file** in case you inadvertently modify important files. I will not be sending you a new copy of the original .zip file or else I will find myself replying to thousands of email messages every month.

0.5 Conventions

There are some conventions to which we will have to adhere in order for the information presented in the text to be clear. Therefore, some information is presented in a font different than that of the regular text.

Most programming code is presented within a framed section:

```
clearinfo
form Hertz-to-Bark converter
⟶comment Enter your value
⟶positive input
⟶choice Formula
⟶⟶button Fourcin (1977)
⟶⟶button Zwicker (1980)
endform
```

where lines are numbered so that you do not lose track of where we are in the script. Most often, numbering takes off where we left it in the previous framed section. When we need to modify an existing line, we count back to the line in question. The right arrows indicate the presence of tabulation. It is my way of telling you that you should use the ⇥ (Tab) key on your keyboard instead of inserting spaces willy-nilly. When a bit of code is presented among regular text, it appears in a typewriter font as well, e.g. `demoWaitForInput`.

When we run a Praat script, we sometimes need to have a visual output. The result of running a script will be presented in a framed box that looks like this and is preceded by the word 'Output':

Output

```
clearinfo
form Hertz-to-Bark converter
        button Zwicker (1980)
endform
```

The path to follow in order to select a menu command appears in this fashion: Praat Objects › Open › Read from file.... File paths aka the location of a file within your Praat folder containing all files for this book, are indicated in the following fashion: 🗀`directory`▸`subdirectory`▸.... Finally, keyboard shortcuts will look like this: Ctrl+L

0.6 Art

Reading text and code for 200+ pages can be exhausting, no matter how gifted the author is. Some visual art can help alleviate the strain on your eyes. This is also going to help us organise information a bit better and detect some key parts of the text.

The objective of the chapter will be stated in the beginning of the section and will be accompanied by the bulls-eye icon. Some text will also be bolded so that you can find the information faster.

Useful information, tips or shortcuts that can help you better understand key concepts will be accompanied by the key image. You might want to pay extra attention to these sections.

The warning icon is not to be ignored. It indicates potential errors that may arise but which can be avoided by you paying extra attention. An ill-compiled script can have catastrophic consequences so think twice before you ignore my warnings.

Whenever we have the opportunity to clean up our code, Mr. Argus[2] will be there to keep you on your toes.

As explained earlier, challenges at the end of each chapter will vary in difficulty. Three levels of craziness are offered: 'easy-peasy', 'I think I can do it' and 'no way in hell!'. The difficulty of each challenge will be indicated by means of one of the three icons on the right.

[2] If you got the Harry Potter reference, hats off to you. And yes, you definitely *are* a nerd. Congrats for having a good taste!

0.7 Help

If you feel stuck on a section, you can try out many things.

First, you should re-read the chapter as many times as needed. Once you finish a chapter, make sure you have understood every notion or else the non-acquired bits will come and haunt you later in the book.

The built-in Praat manual is a treasure of knowledge. It is kept up to date so you should be able to find a description of all commands.

The Praat Users List and its 1900+ members are always here to help. But before you post a question, make sure to look through the 5000+ posts by using the search bar in order to find whether your question has already been asked and answered.

Our Google Group can also help you find answers. Although it has been created so that users can post scripts executing tasks not related to acoustics, you can use it to get answers from the community.

0.8 License

The author of this book (yes, me!) residing in France, French copyright laws are applied; copyright mentions French Legalese can be found on the second page of this file). For those of you who do not speak French, this is how it goes in a nutshell:

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This French-to-English translation was provided by Google Translate so, in case of any mistakes, blame them.

For permission requests, contact me by using the contact form on my website.

The stories, characters, and incidents portrayed in this production are NOT fictitious:[3]. If you have identified yourself as the protagonist of one of my stories, be glad you have had the opportunity to be immortalised and swallow your anger.

0.9 Feedback

My childhood friend Henry James has eloquently said: “Excellence does not require perfection.” I had this in mind when I decided to publish this book.

I have invested approximately 30000 hours (I may be rounding up the numbers but only slightly) preparing this manual, making sure that every bit of information is accurate. Unfortunately, it is possible — though statistically highly improbable — for an error to have crawled its way into this book. So let us transform this experience into an Easter egg hunt: the first one to find the teeniest, tiniest error gets the title of “Master finder”! Will it be you?

If you find any errors, even minor ones, please feel free to visit our website praatintherealworld.com and use the contact form. I am almost open to most suggestions.

0.10 Releases

- ❖ 2024.06.22: First complete electronic edition in English available on praatintherealworld.com.

[3] Only exceptions: the part where I am name-dropping all of my celebrity friends. The truth is, some of them have been refusing to return my calls since the day this book went straight to #1. Sour grapes…

Chapter 1

Installing Praat

You can download Praat for free from the official Website. It is available on the following OS:

- Windows
- Macintosh
- Linux
- Chromebook
- Raspberry Pi
- FreeBSD, SGI, Solaris, HPUX

That's impressive! That is why I love this software! Plus, the source code is also available for those who desire to modify the core of the program and create their own Praat version. For this writing, I am running the 6.3.18 version on a 64-bit Windows 10 Pro installation. Whenever the code presented in this book is not compatible with other OS, I might give you some tip points to make the necessary modification. Keep in mind section 6.9 of the Praat Scripting manual as well as this dedicated post on the Praat Users List.

If you have a 64-bit system, download the 64-bit version for a better performance. If you are not sure about your Windows version, go to Control Panel 》System and look for "System type" (Figures 1.1 and 1.2 respectively).

After you download the zip file, you extract (unzip) the content using a file compression utility (7z, WinZip, WinRar, etc). There is only one file in the .zip (praat.exe) so you can safely extract it anywhere you desire.

1.1 The main interface

To execute Praat, click on "Praat.exe" aka the pink icon (Figure 1.3). Two windows will appear: Praat Objects and Praat Picture. You can use Praat Picture to output information, create graphs, etc. We will not be using it for a while so you can close it.

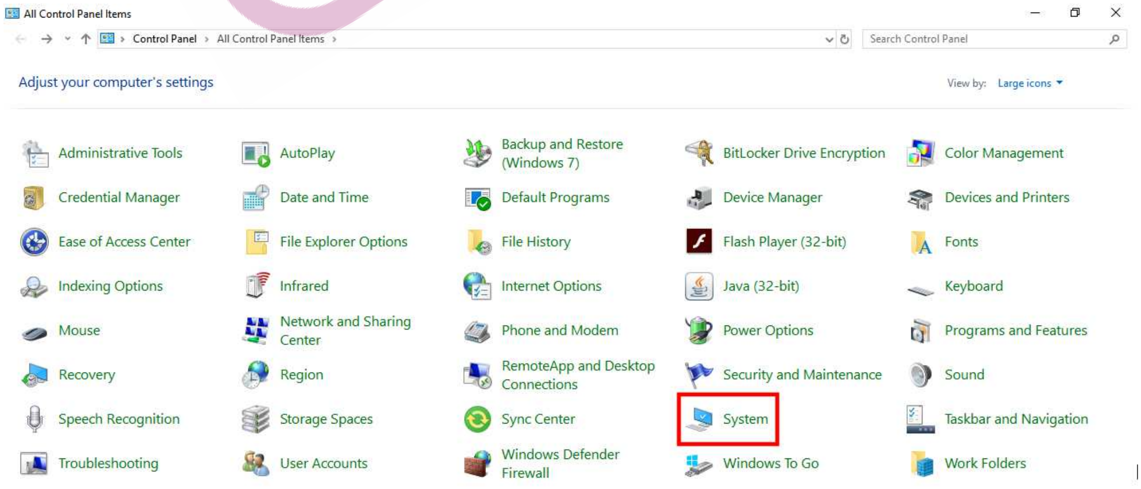
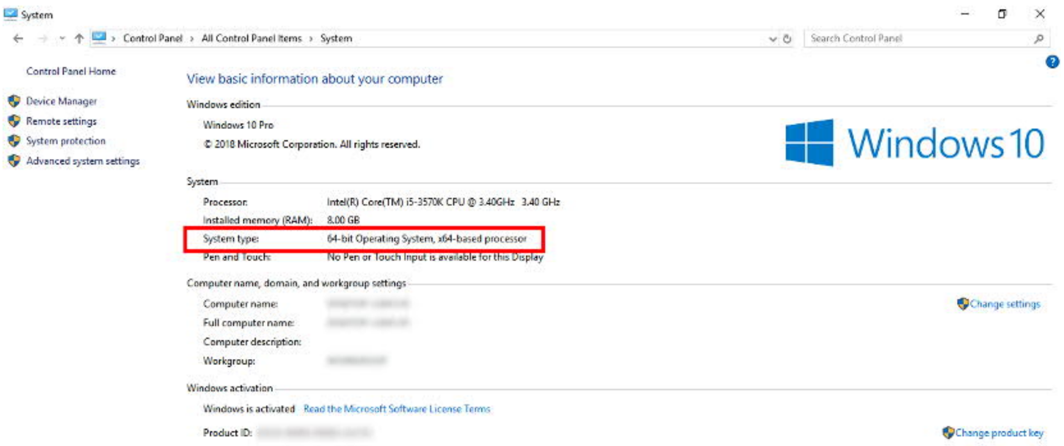


Figure 1.1: The Control Panel in Windows 10



View basic information about your computer

Windows edition

Windows 10 Pro

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System

Processor: Intel(R) Core(TM) i5-3570K CPU @ 3.40GHz 3.40 GHz

Installed memory (RAM): 8.00 GB

System type: 64-bit Operating System, x64-based processor

Pen and Touch: No Pen or Touch Input is available for this Display

Computer name, domain, and workgroup settings

Computer name: [redacted]

Full computer name: [redacted]

Computer description:

Workgroup: [redacted]

Windows activation

Windows is activated Read the Microsoft Software License Terms

Product ID: [redacted]

Figure 1.2: How to check your Windows version in Windows 10.

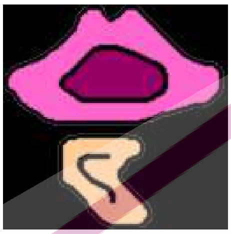


Figure 1.3: The Praat icon.

Praat Objects is the main interface. As long as no files have been opened, the interface is demure: a few menus at the top and a few greyed buttons on the bottom. When you open a file, it becomes an "object" and appears in the white area. Buttons (shortcuts to commands) are object-dependent and will change every time you select an object of a different type. Figures 1.4 and 1.5 illustate the dynamic menus that appear when a Sound and a Table object are selected respectively. You can rename or remove objects by clicking on the corresponding buttons at the bottom.

1.2 Scripts: what's all the fuss about?

A script is a text file containing commands that execute a series of tasks. It is entirely possible to work in Praat without using scripts. This means you will have to click on menus, buttons and more menus to open editors and execute commands. A script allow us to write some commands and, by "running" (executing) it, to tell Praat how to do plenty of stuff without waiting for our input every time.

To create a new script, go to Praat Objects > Praat > New Praat Script. A small window titled "untitled script" should appear. If you start typing, "(modified)" will appear in the title bar of that window, reminding you that you need to save the script to avoid losing the newly added content. Go ahead and try File > Save As.... Name it "proudOfMyFirstEverScript.praat" and save it in a directory (folder). **I suggest you save your scripts in the main directory containing this .pdf file. This will allow you to easily access from within your scripts the auxiliary files necessary for the challenges and projects.** When you are done with a script, you can archive it in a separate folder that you can name "done" or whatever you want to name it. As you can see, .praat is the file extension for scripts. You can use the .txt extension since scripts are plain text files but it is not a good idea; you will have trouble distinguishing scripts and text files containing simple text. When I need to find a script on my computer but do not remember its name, I just type "*.praat" in the search bar. Imagine using .txt for your scripts: you will get hundreds, if not thousands, of results! You can close the script editor. Now let's see how we can open a script. Yep, you guessed it: Praat Objects > Praat > Open Praat Script...

You may have noticed that the script editor is simple: no bells and whistles, just the usual File, Edit, View, etc. menus. Code editors are often quite sophisticated and offer various tools: syntax highlighting, automatic indentation, bracket matching to name a few. Figure 1.6 illustrates what a Praat script looks like in Notepad++ where I have installed a Praat plugin. You forgot to close a parenthesis? The editor

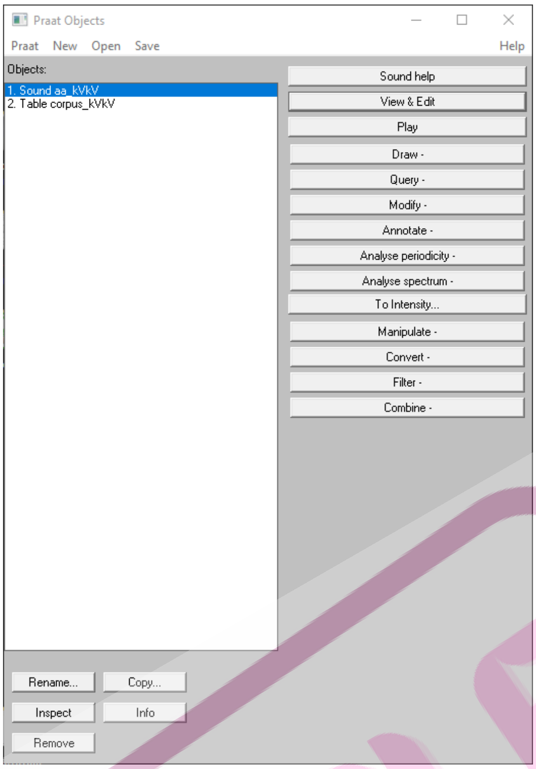


Figure 1.4: The buttons available when a Sound Object is selected.

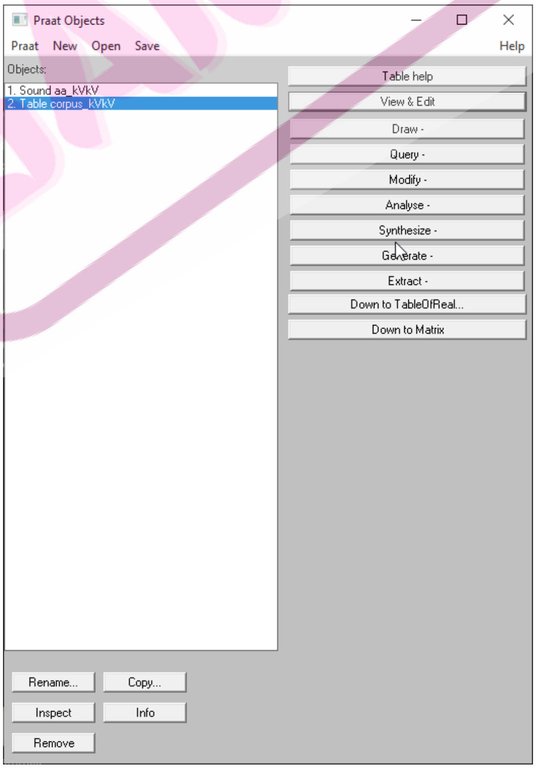
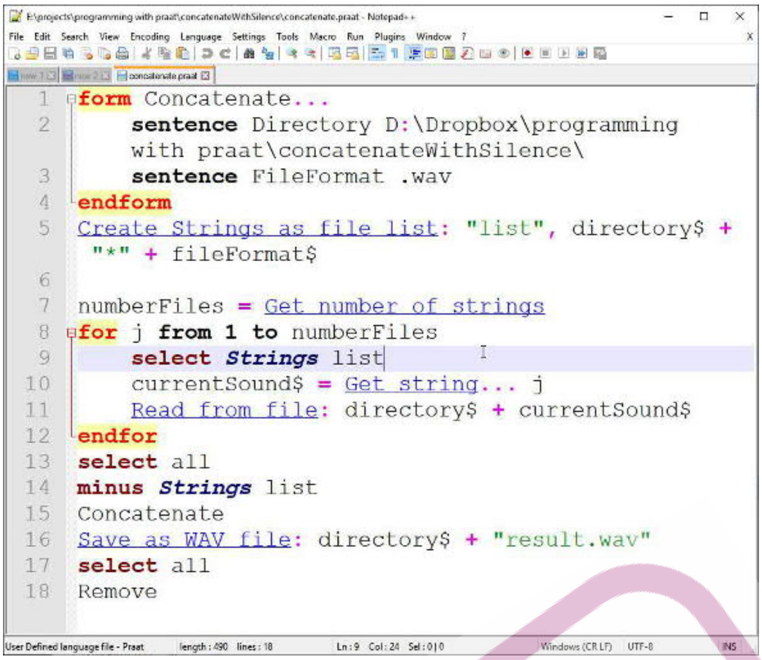


Figure 1.5: The buttons available when a Table Object is selected.


E:\projects\programming with praat\concatenateWithSilence\concatenate.praat - Notepad++
File Edit Search View Encoding Language Settings Tools Macro Run Plugins Window ?
concatenate.praat
User Defined language file - Praat
length : 490 lines : 18
Ln : 9 Col : 24 Sel : 0 | 0
Windows (CR LF) UTF-8 INS

```
form Concatenate...
    sentence Directory D:\Dropbox\programming with praat\concatenateWithSilence\
    sentence FileFormat .wav
endform
Create Strings as file list: "list", directory$ + "*" + fileFormat$

numberFiles = Get number of strings
for j from 1 to numberFiles
    select Strings list
    currentSound$ = Get string... j
    Read from file: directory$ + currentSound$
endfor
select all
minus Strings list
Concatenate
Save as WAV file: directory$ + "result.wav"
select all
Remove
```

Figure 1.6: Syntax highlighting using a Praat plugin in Notepad++.

will remind you by indicating the line. In this book, we will be using the Praat editor because I would like for you to learn the importance of every single comma, parenthesis and whitespace and help you acquire some good reflexes. But as soon as you have learnt how to code and pay attention to all detail, I strongly advise you to make the transition towards a full-fledged text editor. Table 1.1 presents the text editors that support Praat scripting.

1.3 Help

If you do not want to learn all Praat commands and actions by heart, you will need to get accustomed to using the manual. You can access it by clicking on Help at the top right corner of the script editor or that of the Praat Objects window. The two Help menus are a bit different but they will lead you to the same resources. You can either browse through the manual if you know where to find the answer or you can search the manual using the search bar. For our scripts, we will be using mainly the Scripting and the Formulas tutorials.

If you cannot find the solution in the Help manual, you can browse through the resources on Praat's website. For specific questions or for advise on a piece of code you have written, you can address the members of the Praat User List. Be careful however: just like any other programming forum, Praat User List is not there to do the work for you. Do not ask questions such as "How do I analyse a sound?" because members will either ignore you (if you are lucky) or put you in your place (as they should). I have always found a solution on the user list either by searching in the archives or by asking questions.

Table 1.1: Text editors that support Praat scripting. Source: Die Praatpfanne.

Editor	Plugin
Ace	included
Atom	language-praat
Kate	praatKateSyntax
Notepad++	Praat-syntax-highlighting-NPP
Sublime Text	SublimePraat
Sublime Text	praatSublimeSyntax
Vim	vim-praat

1.4 Summary

- ❖ Praat is available on all major OS.
- ❖ The default file extension for scripts is .praat.

1.5 Challenges

1. Create a new script, name it “helloWorld.praat” and save it in your Praat directory. 😆
2. Can you save a Praat script using the .txt file extension? 😆
3. What does the string function “length” do? 😟
4. Open an .mp3 file and find the length of the audio. 😆